DEPARTMENT OF AGRICULTURE.
DIVISION OF CHEMISTRY.
BULLETIN No. 11.

REPORT

OF

EXPERIMENTS

IN THE

MANUFACTURE OF SUGAR

AT

MAGNOLIA STATION, LAWRENCE, LA.,

SEASON OF 1885-'86.

SECOND REPORT.

BY

GUILFORD L. SPENCER,
ASSISTANT CHEMIST.

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LETTERS OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF CHEMISTRY.
Washington, D. C., April 2, 1886.

SIR: I submit herewith for your approval a report of the work done by the Division of Chemistry in the continuation of the investigation of the properties of the sugar-cane and the processes of manufacture of sugar in Louisiana.

In the two seasons during which these investigations have been in progress, many interesting facts relating to the sugar-cane have been brought to the notice of the sugar planters, and the modifications in the processes of manufacture employed, made in harmony with the results of the analyses, have already proved of great pecuniary advantage.

The work during the past year has been under the immediate direction of Mr. G. L. Spencer, who has prepared the report which I now submit.

Respectfully,

H. W. WILEY,
Chemist.

Hon. N. J. COLMAN,
Commissioner.

MARCH 13, 1886.

SIR: I have the honor to submit the following report of the second season's work at Magnolia Experiment Station.

Very respectfully,

G. L. SPENCER,
Assistant Chemist.

Dr. H. W. WILEY,
Chemist.

EXPERIMENTS IN THE MANUFACTURE OF SUGAR.

The work at Magnolia Station for the season of 1885–'86 was commenced November 13, 1885, and completed January 13, 1886. The work of the station this season is of especial importance, giving, as it does, means for comparing the results of two successive campaigns. The value of improvements suggested by last year's experiments is fully demonstrated.

Before giving a detailed account of the experimental work, it may be well to speak of the growing season as compared with last year.

In 1884 the weather was favorable until the first of June; then followed a period of very wet weather lasting until August, which was a very dry month. During September and October the conditions were favorable to the maturing of the cane. The rolling season began November 13, and was frequently interrupted by heavy rain-storms.

The early part of the season of 1885 was exceptionally wet. From April 1 to July 1 the rainfall was limited to three or four showers; in August and September the rains were unusually frequent and heavy; from October until the end of the season the weather was exceptionally dry and cool; the mean temperature being considerably lower than in 1884. The plantation was visited by a severe wind storm September 24. All the heavy cane was blown down and consequently did not ripen. I attribute the low average sucrose and high percentage of reducing sugars as compared with last year to this storm. It undoubtedly cost the plantation not less than 200,000 pounds of sugar. Samples of cane left standing among the fallen cane polarized much higher than the latter and contained a smaller proportion of reducing sugars. Dr. Wiley speaks of a similar loss in his report* on sorghum sugar.

The last of the cane was cut January 1, 1886. At the time of the severe cold weather commencing January 8, 100 tons of cane remained to be ground. At 10 o'clock p. m., January 8, the mills were stopped, the cane being frozen solid. The following morning a pipe from the juice heater was connected with a perforated trough placed above the carrier leading from the shredder. The mill was started and the shredded cane saturated with boiling hot juice. The extraction was so small that this plan was abandoned. January 13, the cane was in a fair condition for rolling and the mill work for the season was soon finished.

* Bulletin No. 3, Chemical Division, Department of Agriculture, pp. 44–46.

It will be seen from the following report that the season of 1885–'86 was a remarkable one in many respects. The average percentage sucrose was low, and the reducing sugars (glucose, invertose, &c.) high. As a consequence of the storm of September 24, much of the cane was in an unripe condition. The tonnage was larger than in 1884. The yield of sugar was fully equal to that of last year and the yield per acre exceeds last season's by about 160 pounds.

IMPROVEMENTS IN THE SUGAR HOUSE.

When the first experiments were made with the shredder,* this machine was placed about 75 feet from the mill. It was located at this distance, so that in case it should fail to do the work required, it could be stopped and the cane be delivered to the mill as ordinarily.

Practice soon demonstrated that the loss of juice, due to dripping from this long carrier, was quite an item. To avoid this loss, the shredder has been placed nearer the three-roll mill and connected therewith by a rubber carrier. The distance from the shredder to the rolls is about 10 feet. In the two seasons the shredder has been used it has not at any time delayed the work.

The iron intermediate carrier was replaced this year by one of rubber. This carrier worked very satisfactorily and is without doubt an improvement over the ordinary form.

The spur wheels, constructed in segments, were replaced by much heavier solid wheels. The new wheels have 14-inch faces and are heavily shrouded. In the season of 1884–'85 the weak spur wheels caused numerous delays; seven segments were broken and replaced by new ones. On account of the weakness in this gearing it was impossible to obtain as good results as this year.

The only accidents to the mills this season, with the exception of the carriers, were the breaking of one turn-plate, one coupling-shaft, and one coupling.

Toward the end of the campaign the mill was stopped by the slipping of a bolt employed to fasten the knife to the turn-plate. This bolt was flattened by the pressure. Less than a week after this detention the turn-plate broke at the place from which the bolt slipped. The plate was probably cracked at the time of the accident to the bolt, and consequently gave way at the first severe strain brought to bear upon it. A wooden turn-plate was substituted and served for the remainder of the crop.

THE BAGASSE BURNER.

The experience of the season of 1884–'85 demonstrated that the bagasse was not furnishing nearly as large a proportion of the steam as it should. To remedy this the burner was entirely rebuilt. The new arrangement worked well. The supply of steam at 110 pounds pressure

* Bulletin No. 5, Chemical Division, Department of Agriculture, p. 60.

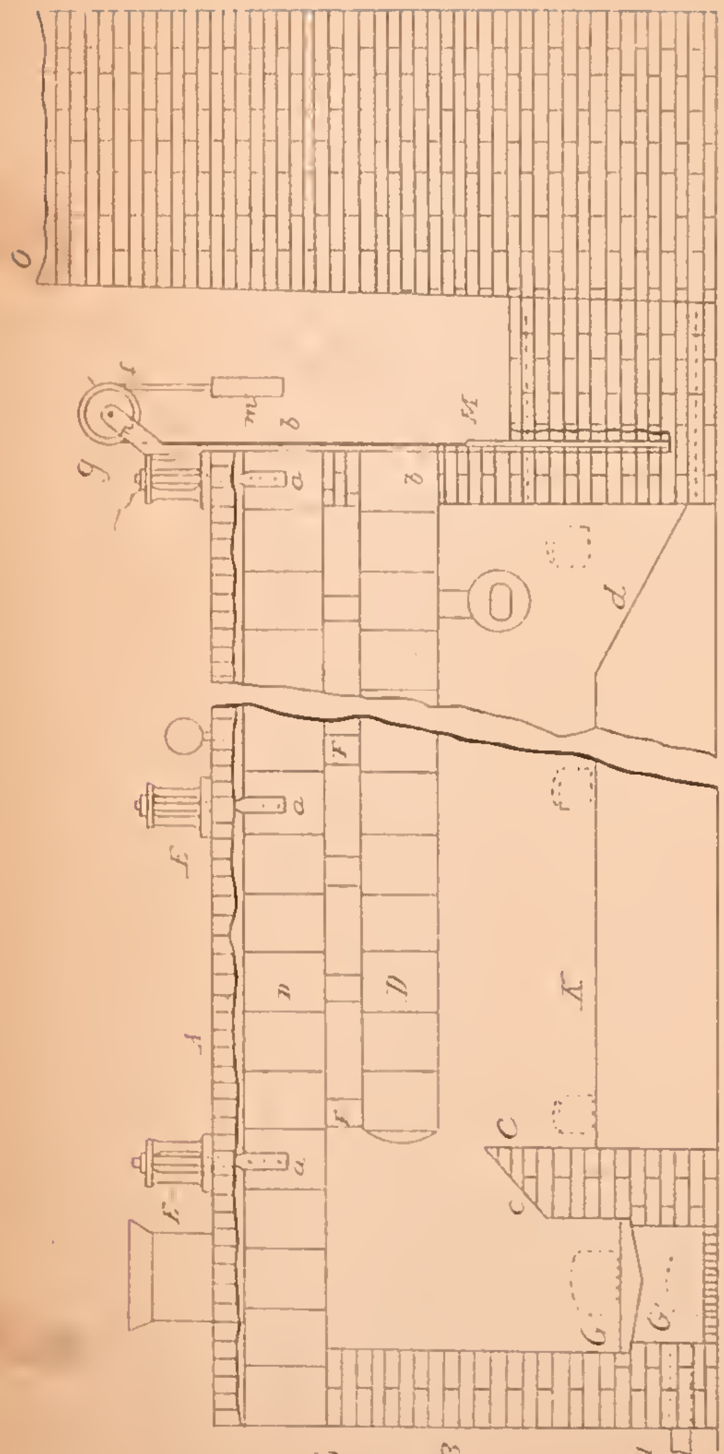

Fig. 1

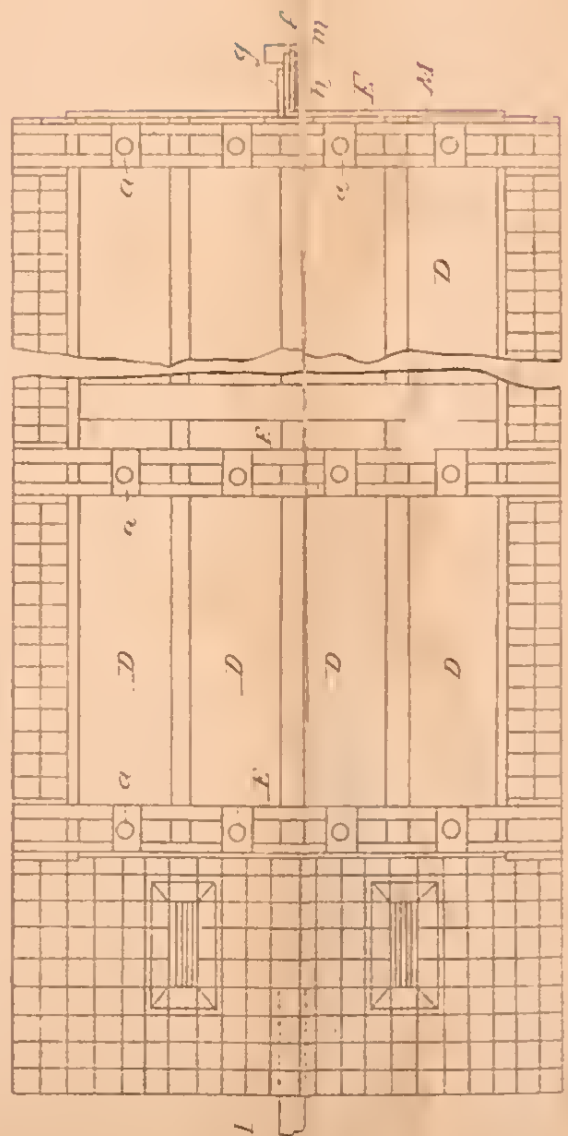

Fig. 2

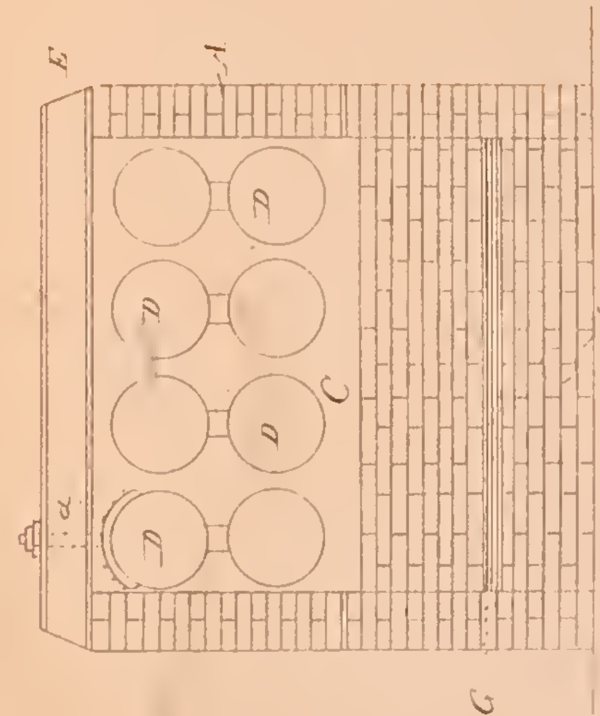

Fig. 3

Improved Bagasse Burner
and
Boiler Setting.

Samuel Fiske
New York

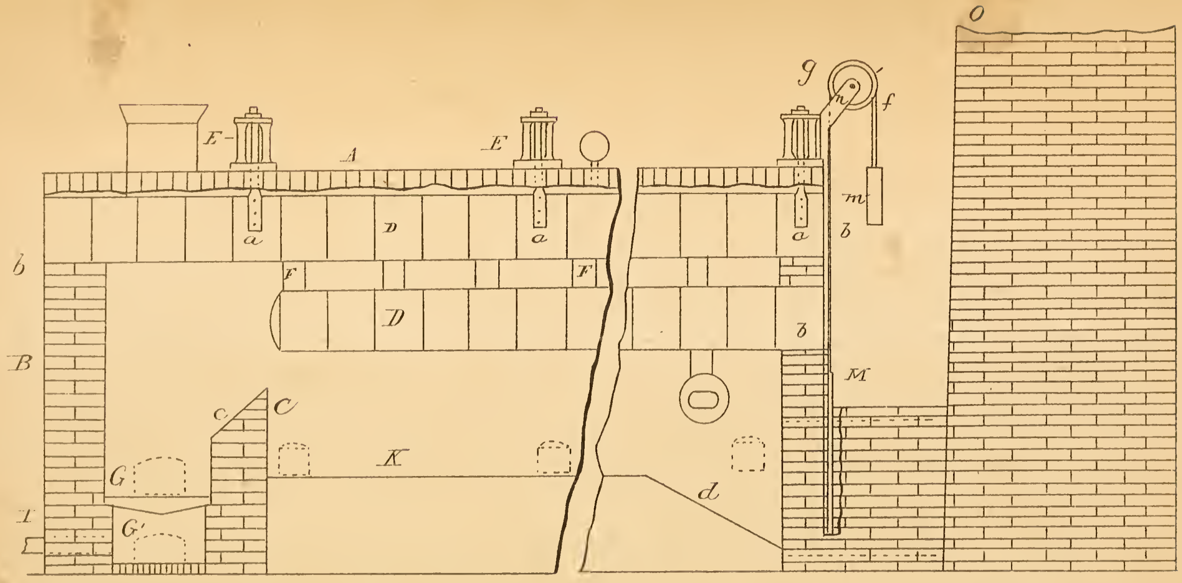

Fig.1.

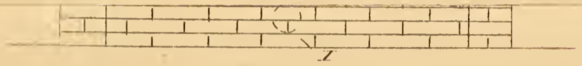

Fig.3.

BELL BROS., PHOTO-LITHOGRAPHERS, WASHINGTON, D.C.

was sufficient for the mill and shredder engine, filter presses, and donkey pump. A valve was so arranged in the steam main that whenever the pressure rose above 110 pounds the steam would escape into the mains from the coal boilers.

The consumption of fuel could be materially reduced by converting the double into a triple effect and employing juice to assist in the* condensation of the vapors from the pans. This method is very largely employed by the European and Cuban manufacturers. It is well known that many Cuban houses make all their steam from the bagasse.

The following description and illustrations, kindly furnished me by Mr. Samuel Fiske, the patentee, will explain the construction of the burner:

The object of this invention is to provide an improved furnace for the utilization of wet bagasse as a fuel under boilers.

The invention consists in enlarging the rear end of the furnace or combustion chamber, and in the application of a damper at the point of greatest enlargement, for the purposes as hereinafter set forth.

Figure 1 is a sectional side elevation with the boilers in position.

Figure 2 is a plan thereof.

Figure 3 is a sectional end elevation of the furnace, with boilers in position.

In the drawings A represents the side walls, B the front wall, and C the bridge wall of the furnace. The horizontal cylinder boilers D, are shown suspended in the upper part of the furnace by hangers, *a*, from iron beams, E, which are laid across the tops of the side walls, and the lower and upper boilers are connected with each other in pairs by connecting tubes or necks, F.

Preferably the boilers of the lower range are shorter than those above, as shown, whereby a larger combustion chamber is had directly over the grate G.

Further support is given to the boilers by the front and rear furnace walls, as shown at B. The grate bars G are designed to be set close enough together to hold the bagasse which will be fed upon them through hoppers, H, in the top of the furnace.

A blast pipe, I, is entered into the ash pit G, to introduce a continuous blast of air from a suitable source.

The fire-bridge wall C is made high in order to increase the capacity of the fireplace, is sloped upward from front to rear, as shown at *c*, for the same reason, and the hearth *k* is made low relatively to the boilers to assure sufficient room for the combustion of the great volumes of gases arising from the burning of wet bagasse.

Though some of these features may not be new, the effective combination of them is not thought to have been before made.

The special features of this improved furnace are the enlargement of the combustion chamber at the throat, made by sloping down the hearth K at the rear end thereof, as shown at *d*, and the location of the chamber M at the point of greatest enlargement of said chamber, or just beyond it.

The damper M is suspended by a chain, *f*, passed over a shear, *g*, whose arbor is journaled in standard *h*, which is secured on the rear pair of beams, E, and on the other end of the chain is a counterbalance, *m*.

The damper is adjusted so as to be moved up and down at the throat of the furnace, or the point of its connection with the horizontal flue leading to the smoke stack *o*, so that when it is closed nearly down, as indicated, it will operate to prevent any serious escape or loss of hot gases up the said stack, and to retain them nearly all

* See illustration of "Calorisateur a Contre Courant," opposite page 114. Bulletin No. 5. Chemical Division, Department of Agriculture.

about the boilers under pressure that facilitates their intermingling and combustion and exalts their temperature.

In operating this furnace a fire is built on the grate, a blast applied through the blast-pipe, and bagasse is then introduced through the hopper or hoppers.

The capacity of the furnace is designed to be sufficient for the complete combustion within it of the air and gases arising from the fire-place, but as time is an important element in the matter, they should be retained in the furnace long enough for complete combustion, and it is also desirable that none of the heated gases should escape into the stack until their temperature has been reduced by contact with, or radiation to, the boiler or furnace walls to about that of steam, hence the damper is located where shown, and not in or on the stack itself, in order to limit the length of the combustion chamber to that of the boiler, to prevent it from extending practically up into the smoke stack and thus rendering useless for generation of steam a greater portion of the fuel.

It will be seen that were the combustion chamber to be of equal area in cross-section throughout, the nearly complete closing of the damper would cause the current of burning gases in the furnace to be so suddenly arrested as to cause an almost instant violent reaction of any current, with probable explosion, before the gases could adjust themselves to the conditions. This is provided against by the enlargement of the furnace, as hereinbefore referred to, whereby, at this point, an excess of room is had for the sufficient, gradual, and safe accommodation of the current of gases to the retardation of its flow when the damper is closed or nearly so.

Were the damper on the top of the stack according to the usual method, the enlargement of the combustion chamber would not be requisite, for in such cases there is always an excess of room in the stack for the current of escaping gases to safely adjust itself to sudden arrest.

The use of dry bagasse for fuel involves no unusual form of boiler furnace, but to successfully use wet bagasse as a fuel, as it is delivered from the rolls full of gas-generating moisture, the form of furnace herein shown and described has been found the most effective and economical known.

The boilers herein shown are well arranged and adapted for use with this furnace, but boilers of other styles can be used with excellent results.

The following temperature observations were made to determine the efficiency of this form of burner:

Temperature in the burner	° Fahr.	2,000
Temperature 20 feet from burner	do	1,280
Temperature 40 feet from burner	do	670
Temperature at the point where the heat passes under and around the fourth boiler to the chimney	° Fahr.	400
Pressure of steam in the boilers	pounds	115
Temperature of steam at 110 pounds pressure	° Fahr.	334.6

These figures are the means of a large number of observations.

The consumption of coal in 1884 was about 2,000 pounds per 1,000 pounds of sugar; in 1885 this proportion was reduced to 1,100 pounds.

The use of a juice-heater* such as is generally employed in German sugar-houses, effected quite an economy in the consumption of steam. The juice was conducted to this heater immediately after leaving the mill, and its temperature raised to 165° F. The effect on the sucrose of heating the raw juice will be discussed further on in this report.

*Bulletin No. 5, Chemical Division, Department of Agriculture, p. 119.

THE TRAMWAY.

The economic transportation of the cane from the field to the carrier is a question of great interest and importance. At the time Governor Warmoth purchased the Magnolia plantation the entire crop was brought to the mill on carts, now all the cane is delivered at the carrier on the tram cars.

Mr. Dustman, the manager, having had considerable experience with carts and also the railway on this place, is eminently fitted to give a comparative view of the working of both methods. The following statements have been obtained through his courtesy:

Total length of railway ... miles..	2
Number of cars ...	160
Number of cars for track service ...	5
The rails are of steel, 14 pounds per yard, and the ties of corrugated steel. Gauge ... feet..	2
Average weight of cars ... pounds..	800
Average weight of load* ... do....	1,900
Weight of cane per train (about) ... tons..	11.5
Number of cars per train ...	12
Number of mules per train ...	2
Number of drivers per train ...	1
Number of trains ...	5
Total number of mules for trains ...	10
Number of trackmen ...	9
Number of boys with trackmen ...	5
Number of mules employed by trackmen ...	5
Number of mules for switching cars ...	2
Total number of mules required for the transportation of 240 tons of cane per day ...	17
Number of loaders ...	32
Number of switchmen ...	2
Number of boys switching cars ...	2
Number of men at cane-carrier, day ...	7
Number of men at cane-carrier, night ...	7
Total number of men and boys employed for the transportation of 240 tons of cane and delivering it to the mill, including loaders ...	69
Transportation of 240 tons of cane in carts:	
Number of loaders ...	32
Number of carts ...	18
Number of teamsters ...	18
Number of mules ...	70
Men at carrier, day ...	15
Men at carrier, night ...	25
Yardmen ...	2
Total number of men ...	92

Résumé, showing running expenses of both systems.

(A) RAILWAY.

5 teamsters, at $1.05 ...	$5 25
9 trackmen, at $1.10 ...	9 90
7 boys, at 50 cents ...	3 50

*In 1884-'85 the cane was straighter than this season, consequently the average load was larger.

2 switchmen, at $1.25	$2 50
7 men at carrier, day, at $1.25	8 75
7 men at carrier, night, at $1.25	8 75
Total	38 65

(B) CARTS.

18 teamsters, at $1.05	$18 90
15 men at carrier, day, at $1	15 00
25 men at carrier, night, at $1	25 00
2 yardmen, at $1.25	2 50
Total	61 40

Balance per day in favor of railway	$22.75
For season of forty-five days	1,023 75

Expenses for loading are the same in both cases.

COST OF RAILWAY.

Steel rails and ties, including duty	$6,900 00
Cars	5,600 00
17 mules, at $200	3,400 00
Total	15,900 00

COST OF CARTS.

18 carts, at $100	$1,800 00
70 mules, at $200	14,000 00
Total	15,800 00

No mention is made in the above statements of interest on investment, since it would be about the same in either case.

The wear and tear on the mules is a large item, and is one which it is impossible to estimate. This item is small, when cane is transported by rail, but is quite large when carts are used.

During a part of the rolling season the mules at Magnolia are employed in plowing. Their work being comparatively light, they require less food than if carting cane over rough roads. Mr. Dustman estimates this saving at 10 pounds of oats and corn per head per day.

In Louisiana, where the cane must be harvested as rapidly as possible, economy of time is of great importance. It is estimated that the loss of time with carts in rainy weather is four times greater than with the railway. Carting in wet weather necessitates a large force of men to keep the roads in repair.

Table I (A) shows the composition of the juices before entering the heater; (B) after leaving it, but before liming.

After sampling the juice at the mill a few minutes were allowed for it to reach the clarifiers before securing the second sample.

TABLE I.—*Analyses of juices.*

[When two analyses are given, same date, the first was sampled at 9 a. m.; second at 4 p. m. If three anslyses are given, first at 9 a. m., second at 12.30 p. m., and third at 4 p. m.]

Date.		Number.	A.						B.					
			Degree Beaumé.	Specific gravity.	Per cent. sucrose.	Per cent. reducing sugars.	Per cent. total solids.	Coefficient of purity.	Degree Beaumé.	Specific gravity.	Per cent. sucrose.	Per cent. reducing sugars.	Per cent. total solids.	Coefficient of purity.
1885.														
Nov.	17	1	9.2	1.0682	12.30	1.61	16.6	74.09	9.2	1.0682	12.78	1.46	16.6	76.98
	20	2	9.3	1.0691	11.81	2.28	16.8	70.29	9.5	1 0704	12.66	......	17.1	74.03
	22	3	8.8	1.0647	11.66	2.07	15.8	73.79	8.9	1.0656	11.96	2.23	16.0	74.75
	23	4	9.3	1.0691	11.71	2.18	16.8	69.70	9.3	1.0691	11.71	2.21	16.8	69.70
	24	5	9.3	1.0691	12.17	1.75	16.8	72.44	9.3	1.0691	12.13	1.82	16.8	72.20
	24	6	9.1	1.0674	12.20	1.76	16.4	74.39	8.8	1.0647	11.34	1.92	15.8	71.77
	25	7	8.7	1.0643	11.39	2.14	15.7	72.54	9.3	1.0691	11.83	2.10	16.8	70.41
	27	8	9.7	1.0722	14.30	.72	17.5	82.28	10.1	1.0753	12.45	.81	18.2	68.40
	27	9	9.7	1.0722	14.18	.59	17.5	81.60	......	....	......	......	......	......
	28	10	9.2	1.0682	13.35	.74	16.6	80.42	9.2	1.0682	13.79	.69	16.6	83.07
	28	11	9.1	1.0674	12.78	.76	16.4	77.92	9.1	1.0674	12.92	.85	16.4	78.78
	28	12	9.3	1.0691	13.18	.82	16.8	78.51	9.4	1.0695	13.37	.85	16.9	79.11
	29	13	9.3	1.0691	13.02	.86	16.8	77.50	9.1	1.0674	13.17	.97	16.4	80.30
	30	14	9.5	1.0704	13.18	.77	17.1	77.07	9.5	1.0704	13.01	.80	17.1	76.08
Dec.	1	15	9.0	1.0665	12.36	1.14	16.2	76.29	9.2	1.0682	12.43	1.12	16 6	74 88
	2	16	9.2	1 0682	13.08	.92	16 6	78.79	9.5	1.0704	13.61	.87	17.1	79.59
	2	17	9.4	1.0695	13.46	.93	16.9	79.64	......	....	......	......	......	......
	3	18	9.5	1.0704	13.37	.89	17.1	78.18	9.6	1.0713	14.08	.86	17.3	81.27
	5	19	9.8	1.0730	14.64	.77	17.7	83.27	10.1	1.0753	14.61	.72	18.2	80.27
	6	20	9.6	1.0713	13.61	.93	17.3	78.72	9.6	1.0713	13.61	.93	17.3	78.67
	7	21	8.9	1.0656	12.77	.97	16.0	79.81	9.4	1.0695	13.03	.99	16.9	77.69
	8	22	9.9	1.0735	15.01	.50	17.8	84.89	10.2	1.0761	15.10	.54	18.4	82.06
	8	23	9.1	1.0674	12.47	1.09	16.4	76.03	9.2	1.0682	12.71	1.02	16.6	76.56
	9	24	9.1	1.0674	12.50	.97	16.4	76.22	9.5	1.0704	13.24	1 01	17.1	77.42
	10	25	9.2	1.0682	12.28	1.09	16.6	73.97	9.1	1.0674	12.41	1.05	16.4	75.67
	10	26	9.2	1.0682	12.79	1.01	16.6	77.04	9.3	1.0691	13.54	.64	16.8	80 59
	11	27	9.1	1.0674	12.44	1.01	16.4	75.85	9.3	1.0691	12.87	1.01	16.8	76.60
	11	28	9.5	1.0704	14.04	.50	17.1	82.10	9 7	1.0722	14.05	.57	17.5	80.86
	12	29	8.6	1.0634	11.43	1.17	15.5	73.74	9.0	1.0665	12.10	1.09	16.2	74.69
	12	30	9.2	1.0682	12.58	.93	16.6	75.78	9.3	1.0691	13.13	.90	16.8	78 15
	14	31	9.4	1.0695	13.01	.99	16.9	76.98	9.4	1.0695	13.13	.80	16.9	77.69
	14	32	9.0	1.0665	12.83	.87	16.2	79.19	9.1	1.0674	12.76	1.02	16.4	77.80
	15	33	8.8	1.0647	12.16	1.01	15.8	76.96	9.1	1.0674	12.66	1.05	16.4	77.19
	16	34	9.3	1.0691	13.24	75	16.8	78.81	9.4	1.0695	13.33	.80	16.9	78.87
	16	35	8.1	1.0596	10.71	1.09	14.6	73.35	8.2	1.0604	10.77	1.23	14.8	72.77
	17	36	8.2	1.0604	10.43	1.32	14.8	70.47	8.4	1.0617	11.29	1.14	15.1	74.76
	17	37	8.1	1.0596	10.92	1.07	14.6	74.79	8.3	1.0609	10.85	1.12	14.9	72.81
	18	38	8.7	1.0647	11.33	1 12	15.7	72.16	8.9	1.0656	11.78	1.33	16.0	73.62
	18	39	8.2	1.0604	10.63	1.18	14.8	71.82	8.2	1.0604	10.57	1.25	14.8	71.41
	19	40	7.9	1.0578	10.46	1.20	14.2	73.66	8.4	1.0617	10.90	1.17	15.1	72.18
	19	41	8.2	1.0604	11.02	1.02	14.8	74.46	8.3	1.0609	11.09	1.12	14.9	74.42
	19	42	8.7	1.0643	12.77	.75	15.7	81.33	9.1	1.0674	12.75	.86	16.4	77.74
	21	43	9.0	1.0665	12.16	.81	16.2	75.06	9.1	1.0674	12.76	.81	16.4	77.80
	21	44	8.7	1.0643	12.22	.82	15.7	77.83	8.9	1.0656	12.48	.77	16.0	78.00
	21	45	8.5	1.0626	11.44	.98	15.3	74.77	8.4	1.0617	11.67	.98	15.1	77.28
	22	46	8.1	1.0596	10.60	1.07	14.6	72.60	8.4	1.0617	11.23	1.09	15.1	80.99
	22	47	8.2	1.0604	11.57	.98	14.8	78.17	8.4	1.0617	11.53	.84	15.1	76.35
	23	48	8.4	1.0617	11.39	1.02	15.1	75.43	8.6	1.0634	11.52	1.12	15.5	74.32
	23	49	8.7	1.0643	12.06	.63	15.7	76.81	8.7	1.0643	12.28	.76	15.7	78.21
	24	50	8.2	1.0604	11.57	.91	14.8	78.17	8.8	1.0647	11.54	.88	15.8	73.03
	24	51	8 2	1.0604	11.17	.80	14.8	75.47	8.6	1.0634	11.53	.86	15.5	74.38
	26	52	8.8	1.0647	12.25	.78	15.8	77.53	9.0	1.0665	12.80	.65	16.2	79.01
	27	53	8.0	1.0580	10.[illegible]1	1.14	14.4	71.59	8.0	1.0580	10.50	1.12	14.4	72.91
	28	54	8.0	1.0580	10.98	1.12	14.4	76.25	8.2	1.0604	10.13	1.02	14.8	68.44
	28	55	8.1	1.0596	11.40	1.07	14.6	78.08	8.5	1.0626	11.53	1.12	15.3	75 36
	29	56	8.5	1.0626	11.46	1.09	15.3	74.90	8.5	1.0626	11.51	1.05	15.3	75 22
	29	57	7.9	1.0578	10.65	1.12	14.2	75.00	8.5	1.0626	11.01	1.07	15.3	71.96
	30	58	8.1	1.0596	11.30	.78	14.6	77 39	8.3	1.0609	11.75	.84	14.9	78.85
	30	59	8.3	1.0609	11.08	1.07	14.9	74.36	8.3	1.0609	11.08	1.07	14.9	74.36
	31	60	8.4	1.0617	11.41	.94	15.1	75.56	8.4	1.0617	11.20	1.02	15.1	74 17
	31	61	8.5	1.0626	11.40	1.07	15.3	74.51	8.3	1.0609	11 60	1.02	14.9	77.85
1886.														
Jan.	2	62	8.4	1.0617	11.53	.89	15.1	76.35	8.6	1 0634	11.95	.78	15 5	77.09
	2	63	8.7	1.0643	12.14	.78	15.7	77.32	8.7	1.0643	12.13	.78	15.7	77.26
	3	64	8.4	1.0617	11.54	.90	15.1	76.42	8.5	1.0626	11.43	.94	15.3	74.70
	4	65	8.6	1.0634	12.03	.81	15.5	77.6	8.8	1.0647	12.38	.81	15.8	78 35
	4	66	8.7	1.0643	12.14	.78	15.7	77.32	8.9	1.0656	12.55	.82	16 0	78 43
	5	67	8.7	1.0643	12.02	.92	15.7	76.56	8.6	1.0634	11 79	.98	15.5	76.06

TABLE I.—*Analyses of juices*—Continued.

Date.		Number.	A. Degree Beaumé.	A. Specific gravity.	A. Per cent. sucrose.	A. Per cent. reducing sugars.	A. Per cent. total solids.	A. Coefficient of purity.	B. Degree Beaumé.	B. Specific gravity.	B. Per cent. sucrose.	B. Per cent. reducing sugars.	B. Per cent. total solids.	B. Coefficient of purity.
1886.														
Jan.	5	68	8.6	1.0634	11.67	.98	15.5	75.29	8.5	1.0626	11.88	.98	15.3	77.64
	6	69	8.6	1.0634	11.57	.98	15.5	74.64	8.7	1.0643	11.56	1.02	15.7	73.63
	6	70	8.5	1.0626	11.27	1.05	15.3	73.66	8.4	1.0617	11.59	.98	15.1	76.75
	7	71	8.4	1.0617	11.53	.78	15.1	76.35	8.5	1.0626	12.04	.78	15.3	78.69
	8	72	8.5	1.0626	12.18	.83	15.3	79.61	9.2	1.0682	12.59	......	16.6	75.84
	8	73	8.5	1.0626	12.47	.71	15.3	81.50	8.9	1.0656	12.02	.81	16.0	75.12
Means		......	8.8	1.0647	12.11	1.02	15.8	76.64	8.9	1.0656	12.24	.96	16.0	76 50

These experiments were made for the purpose of determining the effect of heating the raw juice to a high temperature, also to keep a record of the quality of the juice.

The average temperature to which the juice was heated before liming was 165° F.

Considering that the juice as it comes from the mill is very acid one would expect quite an inversion of sucrose at this temperature. But such is not the case, as is shown by the preceding table. The juice before and after heating contains very nearly precisely the same proportions of sucrose and reducing sugars. I cannot say what the effect would be if it were sulphured before heating.

Attempts were made to determine the acidity of the juice, but owing to a pressure of other work sufficient attention could not be given this question.

TABLE II.—*Comparison of raw and clarified juices.*

Date.		No.	A.—Raw juices. Degree Beaumé.	A.—Raw juices. Per cent. sucrose.	A.—Raw juices. Per cent. reducing sugars.	A.—Raw juices. Coefficient of purity.	B.—Clarified juices. Degree Beaumé.	B.—Clarified juices. Per cent. sucrose.	B.—Clarified juices. Per cent. reducing sugars.	B.—Clarified juices. Coefficient of purity.
1885.										
Nov.	23	4	9.3	11.71	2.18	69.70	10.0	13.39	2.26	74.39
	27	8	9.7	14.30	.72	82.28	10.4	15.44	.80	82.12
	28	10	9.2	13.35	.74	80.42	9.4	13.61	.83	80.53
	30	14	9.5	13.18	.77	77.07	10.2	13.65	.94	73.78
Dec.	1	15	9.0	12.36	1.14	76.29	9.5	13.37	1.18	78.18
	2	17	9.4	13.46	.93	79.64	10.2	14.66	.88	79.24
	3	18	9.5	13.37	.89	78.18	10.0	14.55	.89	80.83
	7	21	8.9	12.77	.97	79.81	9.4	13.65	1.07	80.77
	8	22	9.9	15.01	.50	84.89	10.5	16.00	.57	84.65
	10	25	9.2	12.28	1.09	73.97	9.5	13.12	1.09	76.72
	11	27	9.1	12.44	1.01	75.85	9.5	13.52	1.01	79.06
	12	29	8.6	11.43	1.17	73.74	9.7	13.31	.59	76.05
	14	31	9.4	13.01	.90	76.98	9.8	14.00	.86	79.09
	16	34	9.3	13.24	.75	78.81	9.6	13.85	.86	80.63
	17	36	8.2	10.43	1.32	74.47	8.7	12.13	1.02	77.26
	17	37	8.1	10.92	1.07	74.79	8.5	11.38	1.17	74.38
	18	38	8.7	11.33	1.12	72.16	9.1	11.85	1.17	72.25
	18	39	8.2	10.63	1.18	71.82	8.5	11.11	1.18	72.61
	19	40	7.9	10.46	1.20	73.66	8.7	11.43	.53	72.80
	19	41	8.2	11.02	1.02	74.46	8.8	11.69	1.17	73.98
	19	42	8.7	12.77	.75	81.33	9.4	13.37	.93	79.11
	21	43	9.0	12.16	.81	75.06	9.6	13.49	.80	78.03
	21	44	8.7	12.22	.82	77.83	9.4	13.49	.83	79.82

TABLE II.—*Comparison of raw and clarified juices*—Continued.

Date.	No.	A.—Raw juices.				B.—Clarified juices.			
		Degree Beaumé.	Per cent. sucrose.	Per cent. reducing sugars.	Coefficient of purity.	Degree Beaumé.	Per cent. sucrose.	Per cent. reducing sugars.	Coefficient of purity.
1885.									
Dec. 21	45	8.5	11.44	.98	74.77	8.5	11.97	.98	78.23
22	46	8.1	10.60	1.07	72.60	8.6	11.92	1.09	76.90
22	47	8.2	11.57	.98	78.17	8.9	12.27	.84	76.68
23	48	8.4	11.39	1.02	75.43	8.8	12.17	1.17	77.02
23	49	8.7	12.06	.63	76.81	8.8	12.84	.81	81.26
24	50	8.2	11.57	.91	78.17	8.8	12.21	.98	77.27
24	51	8.2	11.17	.80	75.47	8.6	11.83	.91	76.32
26	52	8.8	12.25	.78	77.53	9.2	12.79	.78	77.04
28	54	8.0	10.98	1.12	76.25	8.6	11.52	1.07	74.32
28	55	8.1	11.40	1.07	78.08	8.5	12.08	1.17	78.95
29	56	8.5	11.46	1.09	74.90	9.0	12.27	1.12	75.74
29	57	7.9	10.65	1.12	75.00	8.3	11.86	1.08	79.59
30	58	8.1	11.30	.78	77.39	8.5	12.27	.91	80.19
30	59	8.3	11.08	1.07	74.36	8.4	11.69	1.14	77.41
31	60	8.4	11.41	.94	75.56	8.7	11.69	1.07	74.45
31	61	8.5	11.40	1.07	74.51	8.7	12.09	1.07	77.00
1886.									
Jan. 2	62	8.4	11.53	.89	76.35	8.6	12.14	.84	78.32
2	63	8.7	12.14	.78	77.32	9.0	12.72	.78	78.52
3	64	8.4	11.54	.90	76.42	8.6	11.65	1.12	75.16
4	65	8.6	12.03	.81	77.61	8.9	12.64	.86	79.00
4	66	8.7	12.14	.78	77.32	9.3	13.15	.81	78.27
5	67	8.7	12.02	.92	76.56	8.9	12.32	.96	77.00
5	68	8.6	11.67	.98	75.29	8.8	11.97	1.07	75.76
6	69	8.6	11.57	.98	74.64	8.9	12.30	1.12	76.87
7	71	8.4	11.53	.78	76.35	9.0	12.55	.93	77.47
8	72	8.5	12.18	.83	79.61	8.9	12.76	.83	79.75
Means ..		8.7	11.92	.96	75.92	9.1	12.73	.98	77.62

Column B represents as nearly as possible the same juice as column A. Analyses of the raw juices are given only for those days when the clarified juices were also examined.

By reference to the table it will be seen that the coefficient of purity has been increased from 75.92 to 77.62. There was practically no change in the relative proportions of the sucrose and reducing sugars. In the raw juice we find 7.72 reducing sugars per cent. of sucrose, and after clarification 7.69 reducing sugars per cent. of sucrose. Figuring the available sugar by the ordinary method, we have 9.10 per cent. in the raw juice, and 10.02 in the clarified. Expressing this in terms more readily comparable, we have 76.24 per cent. of the sucrose in the raw juice available, and 78.71. per cent. in the clarified. This increase in the proportion of available sugar by the process of defecation and clarification is apparently a small one, whereas in fact it is exceedingly important, since the substances removed by the lime and heat are among the most objectionable in the juice.

ALBUMINOIDS.

The average percentage of albuminoids in the juices this season, as compared with last, is shown by the following table :

TABLE III.—*Average percentage of albuminoids.*

	1885–'86.	1884–'85.
Raw juices	.1582	.1862
Clarified juices	.0870	.1011

It is a curious fact that the percentage of albuminoids in 1885–'86 was less than in 1884–'85, notwithstanding the lower purity coefficient of the juice. One would expect a high percentage of albuminoids when the coefficient of purity is low.

In 1884–'85 processes of defecation and clarification removed 45.71 per cent. of the albuminoids; in 1885–'86, 45.01 per cent.

THE FILTER PRESSES.

In the report of last year's work it was shown that there is an enormous loss of sugar in the skimmings and settlings that are thrown into the ditch. Experiments on a small scale indicated that filter presses could be advantageously employed. The results of these experiments were afterwards confirmed by the successful working of large presses.

These presses manufactured by the Hallesche Maschinenfabrik were placed in position ready for the crop of 1885–'86. In consequence of various delays the presses were not started until more than a week of the season had passed. From the beginning of the work with the presses until the end of the season there were no delays caused by failure on their part to properly press the scums. All the skimmings and settlings were pressed. The resulting juice was very clear and bright. The addition of the first washings from the clarifiers and the condensation of the steam in the presses reduced the density of the filtered juice to a little less than that of the clarified juice.

The following table will show the average composition of the juice from the presses:

TABLE IV.—*Analyses of juices from the filter presses.**

Date.	Degree Beaumé.	Per cent. sucrose.	Per cent. reducing sugars.	Per cent. total solids.	Coefficient of purity.
1885.					
Nov. 27	9.7	14.10	.80	17.5	80.57
27	9.8	12.77	.99	17.7	72.14
29	9.2	13.14	.83	16.6	79.15
Dec. 26	8.3	11.11	.94	14.9	74.56
28	8.0	9.67	.81	14.4	67.15
28	8.1	10.61	.91	14.6	72.67
29	8.4	10.15	.73	15.1	67.21
29	8.2	10.02	.81	14.8	67.70
30	8.0	10.37	.71	14.4	72.01
30	8.2	10.66	.84	14.8	72.02
31	8.3	10.81	.72	14.9	72.55
31	8.2	9.86	.71	14.8	66.62
1886.					
Jan. 2	8.7	10.69	.52	15.7	68.09
2	7.8	10.43	.62	14.0	74.50
3	8.3	11.70	.51	14.9	78.52
4	8.9	10.78	.51	16.0	67.37
4	8.3	11.38	.60	14.9	76.38
5	7.8	9.66	.55	14.0	69.00
5	7.8	9.82	.82	14.0	70.14
6	9.1	11.43	1.07	16.4	69.69
7	8.9	11.16	.60	16.0	69.75
8	8.6	11.35	.60	15.0	75.66
Means ..	8.4	10.98	.74	15.1	72.71

* Bulletin No. 5, Chemical Division, Department of Agriculture, p. 57.

Reducing sugar per cent. sucrose = 6.74.

The mean degree Beaumé is .4 lower than that of the normal juice. This difference is due to the addition of the washings from the clarifiers and condensation of steam in the presses.

The mean percentage of total solids is high in proportion to the sucrose, consequently the purity coefficient is low. The mean coefficient for the normal juice is 76.64 and for the juice from the presses 72.71, a difference of 3.93. This is due to a slight decomposition of some of the lime salts. The proportion of reducing sugars is lower than in the normal juice. This indicates that a compound composed of the glucose and lime has been destroyed, leaving the products of the decomposition in solution.

AMOUNT OF SUGAR SAVED BY THE FILTER PRESSES.

Attempts to figure the available sugar would probably prove unsatisfactory. The term "available sugar" expresses at best only a rough approximation, hence only the total weight of the sucrose and reducing sugars is given. As nearly as can be estimated, the net saving in juice effected by the presses was 840,000 pounds.

840,000 × .1098 = 92,232 pounds sucrose.

840,000 × .0074 = 6,216 pounds reducing sugars.

Last season's estimate, based upon experiments with small press, gave 120,316 pounds as the probable loss. This year's experiments show that these estimates were not too large. Had the presses been worked the first few days of the season the amount of sugar would have varied but little from the estimates.

PRESS CAKE.

The press cake still retains a considerable proportion of sugar, as will be seen from the table which follows. This loss could be materially reduced by the methods employed in beet sugar houses. These methods consist either in washing the cake while still in the press or removing it and mixing it thoroughly with hot water and again pressing it.

Date.	Per cent. sucrose.	Date.	Per cent. sucrose.
1885.		1885.	
Dec. 11	4.60	Dec. 31	4.84
14	5.38	31	5.00
21	7.85	1886.	
22	7.60	Jan. 2	6.38
22	6.80	2	5.94
23	6.05	3	7.15
23	7.20	4	5.00
24	6.05	4	6.00
24	6.05	5	6.60
28	4.84	5	6.05
28	7.15	6	5.62
29	5.17	7	5.30
29	7.00	8	6.60
30	7.26		
30	7.70	Mean..	6.19

Total weight of press cake 130 tons; $130 \times .0619 = 8.047$ tons $= 16,094$ pounds sugar.

The press cake can be utilized as a fertilizer. Besides the constituents shown in the table given below, it contains a large amount of lime, which would be a very valuable addition to the stiff soils of Louisiana.

Analyses of press cake.

Number.	Original sample.				Dry sample.		
	Per cent. moisture.	Per cent. ash.	Per cent. phosphoric acid (P_2O_5).	Per cent. nitrogen.	Per cent. ash.	Per cent. phosphoric acid (P_2O_5).	Per cent. nitrogen.
1	47.56	14.05	2.68	1.14	26.89	5.12	2.19
2	42.78	17.30	4.31	1.15	30.24	7.54	2.02
Mean	45.17	15.67	3.49	1.14	28.56	6.33	2.10

When sample No. 2 was taken the pressman was evidently doing better work than at the time No. 1 was sampled. The means represent fair average work.

TABLE V.—*Commercial value of the press cake.*

	No. 1.	No. 2.	Mean.
Pounds of phosphoric acid per ton	53.6	86.2	69.9
Value of phosphoric acid, at 9 cents per pound	\$4 82	\$7 76	\$6 29
Pounds of nitrogen per ton	22.8	23.0	22.9
Value of nitrogen, at 19 cents per pound	\$4 33	\$4 37	\$4 35
Total value of press cake per ton	\$9.15	\$12.13	\$10.64

For a crop of 10,000 tons of cane the commercial value of the press cake (130 tons), on the basis given in the above table, is \$1,383.20. This alone, aside from the sugar saved, is a very large interest on the cost of the filter presses. It is far better to utilize these valuable constituents than to pollute the ditches with a stream of sour skimmings.

MANAGEMENT OF THE FILTER PRESSES.

The skimming and settlings from the clarifiers are collected as usual in settling tanks and the clear juice is drawn off. This previous settling reduces the wear and tear on the filter cloths and economizes time. The sediment is forced into the presses by a pump at a pressure of about 60 pounds. The juice will run very freely at first; soon the cloths begin to clog, and the volume of juice rapidly diminishes. When it almost ceases to flow the inlet for the skimming must be closed and boiler pressure applied through the steam inlet; the steam is shut off and the skimmings are again pumped into the press. This operation is repeated two or three times, and finally, when the flow of juice almost entirely ceases, steam pressure must be applied until the press cake is thoroughly dried. This may be determined usually by the steam blow.

ing out of all the juice cocks. The steam is shut off and the escape valve opened to relieve the pressure.

The filter is then opened and the press cake detached from the cloths by a flat piece of wood. Immediately after removing the cakes the press is closed and is ready for another charge. It is not advisable to use one set of cloths more than forty-eight hours without washing. The best cloths are made of jute and are imported from Europe. A very good quality of cloth can be obtained in New York.

EXPENSES OF WORKING FILTER PRESSES.

These estimates are for a house working about 250 tons per day. Larger houses would require a proportionately larger number of presses, though but little more labor.

Cost of three presses, twenty-five chambers, at $800	$2,400
Cost of cloth	300
	2,700

Pumps and fittings additional.

Labor:	
One man at presses, at $1.50, forty-five days	$67 50
One laborer to assist pressman to wash cloths, forty-five days, at $1	45 00
One man and cart, forty-five days, at $2.50	112 50
Total	225 00

The expense for new cloths amounts to about $100 per season. Much of the damage to the cloths is the result of carelessness on the part of the pressman. Immediately after removing them from the presses they should be washed in boiling water.

LOSS OF JUICE IN THE WASHINGS FROM THE CLARIFIERS.

Immediately after drawing off the clear juice from the clarifiers it is customary to throw in a few pails of water to wash the coils. If the workman is pressed for time, he will often open the waste valve and run the last portions of the juice into the ditch.

Experiments were made to determine the extent of this loss.

The men at the clarifiers were not warned that the samples were to be taken. In the following table the samples in column A were taken first, and a half minute later those in B:

TABLE VI.—*Per cent. of sucrose.*

Number.	A.	B.
1	4.90	.60
2	5.25	1.85
3	5.90	1.00
4	7.25	5.60
Means	5.82	2.26

It is evident that when sample No. 4 was taken, the waste valve had been opened too soon.

It is difficult to estimate the loss from this source. Supposing that 25 pounds of juice ran out before it became preceptibly weaker, and considering 5.82 a fair average content of sucrose, the loss would be as follows:

Twenty-five pounds multiplied by .0582=1.45 pounds sucrose; multiplying 1.45 by 3,207 the total number of clarifiers, we have the loss of sucrose 4,650 pounds. This loss is comparatively insignificant. With careful work it would probably not be greater than is indicated by the above analyses. But if the house is being worked to its full capacity, the chances are that the waste valve will often be opened before all the juice has run out of the clarifier, entailing a loss of several gallons of juice. It is a far safer plan to run all the washings from the clarifiers into the skimming tanks. It would be even better to have but two outlets from the clarifiers, one into the storage tanks for clarified juice, and the other into the tanks for skimmings. It will be more economical to evaporate the additional water than risk the loss of large quantities of juice.

THE PROPORTION OF FIBER OR MARC IN THE CANE.

It is self evident that the proportion of available juice in sugar-cane depends upon the amount of woody fiber; this, of course assuming it is to be extracted by milling. We know that if a piece of moist wood be subjected to the greatest pressure we can apply, at a certain period of the operation it is impossible to express more water, but upon drying there is a further loss. The fiber acts as a sponge and prevents complete drying of the sample by pressure. So it is with the cane, the larger the proportion of fiber, the smaller will be the proportion of the total juice that is available. Hence the importance of knowing the amount of fiber in the cane in order to be able to make comparable statements in regard to the efficiency of mills.

Experiments made in the tropics are of no direct value to us, though they are certainly of interest for comparison. The climatic and soil conditions are so different in tropical countries that they must surely affect the cane. In Cuba, for example, cane is harvested from the same piece of land ten or twelve years in succession without replanting. We know that the proportion of fiber increases each year, hence it would be fair to expect a lower average extraction in Cuba than in Louisiana, where cane ratoons but twice. To offset this in a certain degree we have the greater maturity of cane grown in tropical countries. It would seem reasonable to expect plant cane in the tropics to contain a very small proportion of fiber, but Professor McCulloch* finds the opposite to be the case. The same authority gives 85 per cent. as the probable average juice in the Louisiana cane. From data given further on, I consider even 90½ per cent. rather a low average.

* See paper read before Louisiana Planters' Association, January meeting, 1886.

The following experiments were made at the Magnolia station. They will bear me out, I think, in the statements I have made, and will throw additional light on this subject.

Fresh canes were cut into thin slices at right angles to their axes. These slices were so subdivided that in each piece the rind and pulp were in the same proportionate quantities as in the original cane. This work was done very quickly to reduce the error from the drying of the sample. After thoroughly mixing, 50 grams were weighed out and treated with fifteen successive portions of boiling water, the chips being immersed at least ten minutes each time. The insoluble residue was dried at 110° C. (230° F.) to constant weight.

Properly speaking this residue is not the pure fiber, but contains other bodies. I have employed the term "fiber," owing to its general use by the planters of Louisiana. The word "marc" is the generally recognized expression for the insoluble part of the cane or beet.

The following are the results of the analyses:

PLANT CANE.

	Per cent. marc.
(1) Purple cane	7.28
(2) Purple cane	9.57
(3) Purple cane	9.55
(4) Purple cane	9.96
(5) Purple cane	8.92
(6) Purple cane	8.29
(7) Purple cane	7.57
(8) Purple cane	8.94
(9) Purple cane	6.17
(10) Purple cane	8.29
(11) Purple cane	8.81
(12) Purple cane	8.78
(13) Crystalline cane	8.26
Mean	8.47

FIRST RATOONS

(1) Ribbon cane	10.17
(2) Purple cane	10.56
(3) Purple cane	10.93
(4) Purple cane	9.93
(5) Purple cane	10.23
(6) Purple cane	10.62
Mean	10.41

Mean per cent. juice, plant cane	91.53
Mean per cent. juice, first ratoons	89.59
Highest per cent. juice, plant cane	93.83
Lowest per cent. juice, plant cane	90.04
Highest per cent. juice, first ratoons	90.07
Lowest per cent. juice, first ratoons	89.07
Difference between highest and lowest percentages of juice in plant cane	3.79
Difference between highest and lowest percentages of juice in first ratoons	1.00

On the supposition that a crop of cane consists of 40 per cent. first ratoons and 60 per cent. plant, we have the following averages: 60 per cent. of 91.53 = 54.92 juice from plant cane; 40 per cent. of 89.59 = 35.84 juice from first ratoons; average per cent. juice from all cane = 54.92 + 35.84 = 90.76.

Judging from results obtained in the tropics, a larger range in the proportion of the marc would have been expected. It is very probable that cane from land yielding 30 tons per acre would contain less fiber. The Magnolia yield was a little less than 20 tons.

To check the results obtained by the method described for determining the marc, indirect experiments were made, based upon the amount of water in the juice and in the cane.

The results by the two methods agreed very closely.

THEORETICAL EXTRACTION.

It is an interesting problem to determine the efficiency of the mills from the analysis of the juice and the bagasse. This can be accomplished in two ways, viz: (1) From the total sugars in the juice and the bagasse and the per cent. of juice in the cane; (2) from the percentages of water in the bagasse and juice and the percentage of juice in the cane. The first method is not so reliable as the second, owing to two sources of error arising from the difficulty in accurately determining the sugars in the bagasse and the necessity of taking the mean of a number of analyses for the proportion of juice in the cane. The only important source of error in the second method is due to the last-named cause. The first method gives results obviously too high and in the second the results are a little low. Of course such determinations as these give the extraction only at the time of taking the samples. If the mills are working steadily twenty-two hours or more per day, with a regular feed, the results will vary but little from the theoretical extraction. The results are especially interesting where the work of the three and two roll mills are compared.

The following is a description of the second method, which is the one adopted for this work.

A sample of juice is taken at the box. The bagasse from the same cane is also sampled.

The percentages of water in the bagasse and in the juice are determined. The kind of cane, whether plant or stubble, is noted. It is preferable to determine the amount of juice in cane passing through mills at the time of taking the samples, but owing to a pressure of other work it is not usually convenient to do so. For very accurate work, of course this would be necessary.

The following are the formulas for the calculations:

$$\frac{W}{w} \times 100 = J \ \ldots\ldots(a); \quad 100 - J = I \ \ldots\ldots(b).$$

$$I \times F = C \ \ldots\ldots(c); \quad \frac{100}{c} \times 100 = \text{per cent. of bagasse.}$$

W = the percentage of water in the bagasse.
w = the percentage of water in the juice.
J = the percentage of juice in the bagasse.
I = the percentage of insoluble matter in the bagasse.
F = the amount of cane represented by each unit of insoluble residue in the cane.

Example.—December 9, first ratoons.

Per cent. water in the bagasse 47.27
Per cent. water in the juice 84.82
Per cent. juice in the cane (average for first ratoons) 89.59
Per cent. insoluble matter in cane 10.41

$$\frac{100}{10.41} = 9.606 = F.$$

$$\frac{47.27}{84.82} \times 100 = 55.73 = J \ \ldots\ldots(a); \quad 100 - 55.73 = 44.27 = I \ldots\ldots(b).$$

$$47.27 \times 9.606 = 425.26 = C \ \ldots\ldots(c).$$

$\frac{100}{425.26} \times 100 = 23.51$ per cent. of bagasse, and $100 - 23.51 = 76.49$ per cent. extraction.

TABLE VII.—*Theoretical extraction.*

Date.	No.	Cane.	Per cent. solids in juice.	Five-roll mill.			Three-roll mill.			Two-roll mill.
				Per cent. water in bagasse.	Per cent. bagasse.	Per cent. juice extracted.	Per cent. water in bagasse.	Per cent. bagasse.	Per cent. juice extracted.	Per cent. juice extracted.
Dec. 7	1	Ratoons ..	14.80	50.61	25.64	74.36	....	....	....	....
8	2	... do	16.48	52.32	27.86	72.14	....	....	....	....
9	3	.. do	15.18	47.27	23.51	76.49	....	....	....	....
*10	4	.. do	15.37	54.76	29.39	70.61	....	....	....	....
†10	5	....do	15.37	51.54	26.62	73.38	....	....	....	....
*11	6	....do	15.20	53.12	27.86	72.14	57.58	32.43	67.57	4.57
†11	7	....do	15.83	51.33	26.67	73.33	....	....	....	....
12	8	... do	14.35	52.34	26.76	73.24	59.41	33.97	66.03	7.21
*14	9	....do	15 65	53.11	28.00	72.00	62.68	40.51	59.49	12.51
†14	10	....do	15.00	52.21	26.98	73.02	....	....	....	....
15	11	....do	14.63	54.24	28.35	71.65	59.90	34.88	65.12	6.53
16	12	Plant	12.52	56.39	23.83	76.17	59.87	26.83	73.17	3.00
17	13	...do	13.34	52.44	21.45	78.55	59.62	27.13	72.87	5.68
18	14	....do	14.56	53.61	22.73	77.27	65.31	35.93	64.07	13.20
19	15	.. do	12.95	54.77	22.84	77 16	58.34	25.68	74 32	2.84
21	16	Ratoons ..	15.00	50.65	25.75	74.25	56.55	31.10	68.90	5.35
22	17	Plant	14.15	52.25	21.64	78.36	59.28	27.36	72.64	5.72
23	18	....do	14.00	53.75	22.58	77.42	56.23	24.58	75.42	2.00
24	19	Ratoons ..	15.00	52.94	27.59	72.41	58.94	33.95	66.05	6.36
28	20	Plant	14.00	53.85	22.65	77.35	57.41	25 47	74.53	2.82
29	21	...do	13.38	52.93	21.77	78.23	56.10	24.03	75.97	2.26
30	22	...do	13.50	54.61	22.97	77.03	61.42	29.21	70.79	6.24
31	23	...do	13.80	52.92	21.93	78.07	59.35	27.19	72.81	5.26

* Sample taken in the morning. † Sample taken in the afternoon.

Analyses Nos. 9 and 14 show that the three-roll mill was doing unusually poor work at the time of taking the samples. Rejecting these two results, we find that the two-roll mill expressed from 3 to 8 per

cent. of the juice. Even when the extraction by this mill was but 3 per cent. of the total juice there was quite a decided reduction in the proportion of water in the bagasse.

The bagasse from ratoons contains less water than that from plant cane. A casual observer, judging from the "feel" of the bagasse only, would naturally suppose that the mill was expressing more juice when working on ratoons than when rolling plant cane. Such is not the case, since the plant contains a larger proportion of available juice than the ratoons. Before judging the work of a mill from the moisture left in the bagasse the question should always be asked, what kind of cane are you grinding; plant or ratoons?

ANALYSES OF THE TOP JOINTS OF THE CANE.

The top red and a very small part of the lowest green joints of 164 canes selected at random were examined to determine the proper joint at which to top the cane.

These pieces of cane weighed 21.75 pounds and had an average weight of .133 pounds. The average weight of 475 canes in 1884–'85 was 1.85 pounds. There were 48,000 pounds of this cane per acre. On the assumption that each cane weighed 1.85 pounds there were 25,945 canes, and the weight of the tops was $25{,}945 \times .133 = 2{,}451$. The percentage of sucrose in the tops was 9.35, the reducing sugars 2.34, and the total solids 15.8. Figuring available sugar by the usual method we have $9.35 - [15.8 - (9.35 \times 2.34)] = 5.24$ per cent., and the available sugar per acre, $3{,}451 \times .0524 = 180.8$ pounds.

For 484 acres, the Magnolia acreage, this amounts to 87,507 pounds of sugar.

This experiment shows very plainly that careless topping results in an enormous loss to the planter. The cane should be topped below the lowest green joint, but rather than risk topping too low it would be better to leave a small portion of the green part of the cane.

*Analyses were also made of different parts of the cane. The results are given in the table below. The letters *a*, *b*, *c*, and *d* represent respectively the top, upper middle, lower middle, and bottom quarters of the canes.

a		*b*		*c*		*d*	
Per cent. sucrose.	Per cent. reducing sugars.	Per cent. sucrose.	Per cent. reducing sugars.	Per cent. sucrose.	Per cent. reducing sugars.	Per cent. sucrose.	Per cent. reducing sugars.
6.59	2.61	11.77	1.29	15.48	0.46	15.54	0.21
5.91	3.11	13.06	1.33	16.38	0.55	16.82	0.28
4.55	4.30	10.00	1.18	13.66	1.14	14.35	1.01
5.68	3.34	11.61	1.27	15.17	0.72	15.57	0.50

*These analyses were made by Dr. C. A. Crampton.

ANALYSES OF SUGARS.

TABLE VIII.—*First sugars.*

Date.	No.	Lot.	Per cent. sucrose.	Date.	No.	Lot.	Per cent. sucrose.
1885.				1885.			
Nov. 20	1	1	98.2	Dec. 24	15	25	97.7
Dec. 8	2	11	98.7	27	16	26	98.0
10	3	13	97.8	28	17	27	96.6
11	4	14	98.4	29	18	28	97.7
12	5	15	97.1	30	19	29	97.0
14	6	16	97.6	31	20	30	97.7
16	7	17	97.8	1886.			
17	8	18	97.1	Jan. 1	21	31	97.3
18	9	19	96.6	3	22	32	97.3
19	10	20	97.2	5	23	33	97.3
20	11	21	97.2	7	24	34	97.6
21	12	22	97.4	7	25	35	97.5
22	13	23	97.4	8	26	36	97.6
23	14	24	97.1				
				Mean..	......	......	97.48

TABLE IX.—*Second sugars.*

Date.	No.	Lot.	Per cent. sucrose, direct polarization.	Per cent. sucrose, double polarization.	Date.	No.	Lot.	Per cent. sucrose, direct polarization.	Per cent. sucrose, double polarization.
1885.					1886.				
Dec. 6	1	1	92.0	....	Jan. 2	10	10	89.2	91.89
8	2	2	90.3	....	5	11	11	91.5	93.24
10	3	3	89.0	....	8	12	12	87.7	89.97
15	4	4	89.9	....	15	13	14	88.3	90.17
17	5	5	88.8	91.05	16	14	15	89.9	91.93
20	6	6	90.3	92.22					
22	7	7	89.8	91.77	Means..	......	......	89.60	91.39
23	8	8	88.8	90.56					
31	9	9	89.0	91.14					

REMARKS ON TABLES VIII AND IX.

Sugars are usually sold on a basis of the direct polarization. Both the direct and double polarizations are given in Table IX. The double polarization gives the actual percentage of sucrose present.

The first sugars were yellow clarified, grained in the pan, and the seconds string sugar. About half a pint of water per centrifugal was used in washing the first sugar and two or three times this quantity for the seconds.

After these analyses were made, I learned that an error* had been discovered in the determination of the quantity of pure sugar required to give a reading of 100 with the Laurent polariscope. The quantity to be taken, as given by the maker of this instrument, is 16.19 grams, instead of 16.30 grams, the correct amount, as determined by Messrs.

* D. Sidersky in "Bulletin de l'Association des Chimistes," p. 255, Nos. 8 and 9, 1885. Mr. Clifford Richardson, Department of Agriculture, also made a note of this error in the American Chemical Journ., Vol. 8, pp. 51–52.

Sidersky and Richardson. The percentages obtained, taking the factor 16.19 should be increased .68 per cent. This error affects the low percentages of sucrose very little, but quite marked in high-grade sugars and sirups. A correction has been made for this error in all tables of analyses.

The paper referred to in the foot-note gives a full discussion of this source of error.

TABLE X.—*Analyses of molasses.*

Date.	Per cent. sucrose, direct polarization.	Per cent. sucrose, double polarization.	Per cent. sucrose, Fehling's method.	Per cent. reducing sugars.
1885.				
Dec. 14	....	....	27.72	16.67
19	....	....	33.60	19.53
20	24.10	36.01	....	21.45
21	....	....	25.91	15.83
23	22.50	33.46	....	19.60
28	23.30	34.36	....	28.55
31	....	....	33.41	20.83
1886.				
Jan. 1	24.50	34.94	....	20.00

Average per cent. sucrose as determined by double polarization and Fehling's method=32.43. Average per cent. reducing sugars, 20.31.

In the following summary and other tables the figures in regard to the extraction and yield of sugars were taken from the sugar-house records:

TABLE XI.—*Date of working, period, description of field, area of field, soil, age of cane, amount of fertilizer, total yield, and yield of cane per acre, analyses of juices.*

Date.*	No. of period.	Strip.	Area of strip.	Soil.	Cane.	Fertilizer. Cotton seed meal per acre.	Fertilizer. Superphosphates per acre.	Total cane.	Cane per acre.	Sucrose.	Reducing sugars.	Coefficient of purity.
1885.			*Acres.*			*Pounds.*	*Pounds.*	*Tons.*	*Tons.*	*Per cent.*	*Per cent.*	
Nov. 13–17	1	"Magnolia"	15	Stiff black	First stubble	500	250	321.759	21.45	12.30	1.61	74.09
18–21	1	"Railroad"	35	do	Second stubble	500		471.286	13.51	11.81	2.28	70.29
21	1	"Stable"	4	Sandy and stiff	do	500		63.377	15.84			
22–27	1	"Polly Garden"	42.30	do	First stubble	500	250	824.953	19.50	11.82	1.98	72.29
26	1	(Purchased cane)						50.251				
27–28	1	"Pond"	1.15	Sandy and stiff, mixed	First stubble	500	250	23.003	19.94	13.29	.83	78.87
Dec. 2	2	do	42.85	do	do	500	250	854.492	19.94	13.29	.83	78.87
3	2	(Purchased cane)						258.897				
5–6	3	"Church"	22.51	Sandy and stiff, mixed	First stubble	500	250	509.243	22.62	13.61	.93	78.67
8	3	(Purchased cane)						200.000				
7–12	3	"Lower Front"	40.22	Sandy and stiff, mixed	First stubble	500	250	948.245	23.55	12.54	.98	76.69
12–16	4	do	18.28	do	do	500	250	429.633	23.55	12.54	.98	76.69
16	4	(Purchased cane)						33.100				
16–19	4	"Molly Shanty"	30	Stiff black	Plant	225	225	698.859	23.30	16.78	1.14	72.84
19–21	4	"Pasture"	26	Black	First stubble	(†)	(†)	458.980	17.65	12.38	.79	78.35
21, 22	4	"Swinging Oak"	11	Stiff black	Plant	225	225	271.407	24.67	11.62	1.02	73.29
22, 23	4	"Cypress"	13	do	do	225	225	273.409	21.03	11.48	1.00	77.05
23, 24	4	"Swinging Oak"	11	do	First stubble	(†)	(†)	194.250	17.66	11.81	.77	77.44
24	4	"Cypress"	2.07	do	do	(†)	(†)	33.219	16.04	11.71	.79	76.53
26, 27	5	do	19.93	do	do	(†)	(†)	319.677	16.04	11.71	.79	76.53
27	5	"Swinging Oak"	9	do	Plant	225	225	183.557	20.39	10.64	1.13	73.85
28, 29	5	"Cypress"	13	do	do	225	225	273.407	21.03	11.43	1.08	76.71
29, 30	5	"New Land"	30	do	do	600		456.103	15.20	11.01	.99	75.41
31	5	do	9.56	do	First stubble	500	250	207.508	21.70	11.44	.97	75.76
1886.												
Jan. 2	6	do	.42	do	do	500	250	9.151	21.70	11.44	.97	75.76
2, 3	6	"Wood Pile"	18.50	Sandy and stiff	Plant	225	225	244.212	13.20	11.84	.84	76.63
3	6	"48-Acre"	9	Stiff black	do	225	225	135.225	15.02	12.06	.83	76.81
4	6	"Upper Front"	18	Sandy	do	225	225	248.734	13.81	11.62	.98	74.96
5	6	"48-Acre"	6	Stiff black	do	225	225	93.812	15.63	11.40	.91	74.75
6–13	6	"Long Rows"	37	Sandy and stiff, mixed	do	225	225	762.151	20.60	12.33	.77	80.59
		Total	484.79					9,851.900	‡19.20			

* The divisions of the season into periods were arbitrary, and were made when bad weather or other cause of delay permitted a thorough cleaning of the sugar-house.

† No fertilizer.

‡ Mean.

TABLE XII.—*Showing tons of cane worked, weight of juice extracted, per cent. of extraction, weight of first and second sugars, and total weight of first, second, and third sugars (thirds estimated) per ton of cane for the six periods into which the season was divided.*

	First period.	Second period.	Third period.	Fourth period.	Fifth period.	Sixth period.	Total.
Cane worked .... tons..	1, 754, 629	1, 113, 388	1, 657, 488	2, 392, 857	1, 440, 376	1, 493, 262	9, 851, 900
Juice extracted .... pounds .	2, 683, 614	1, 759, 375	2, 547. 410	3, 749, 920	2, 277, 553	2, 365, 249	15, 383, 121
Per cent. of extraction.......	76. 47	79. 09	77. 17	78. 35	79. 06	79. 19	78. 07
First and second sugars per ton (molasses not included) pounds	129. 20	170. 07	162. 97	139. 07	136. 89	154. 30	148. 75
First, second, and third sugars per ton (molasses not included) .....pounds..	144. 20	185. 07	177. 97	154. 07	151. 89	169. 30	163. 75

Per cent. of yield (sugars) 8. 18

Pounds of first sugar (polarization 97.48 per cent.) per ton of cane (72.67 per cent. of the whole).. 119

Proceeds of second sugar (polarization, double, 91.31 per cent., direct, 89.60 per cent.) per ton of cane (18.16 per cent. of the whole) 29. 75

Pounds of third sugar estimated per ton of cane (9.17 per cent. of the whole).. 15

Sugar made ....pounds.. 1, 613, 743

TABLE XIII.—*Comparison of yield of sugars and molasses, season of 1885–'86 with same for* 1884–'85.

	1885–'86.	1884–'85.
Per cent. of yield of first and second sugars..........	7. 43	6. 87
Per cent. of yield of all sugars	8. 18	7. 92
Yield of all sugars per ton of cane, pounds..............	163. 75	158. 42
Yield of molasses per ton of cane, pounds		58. 25

CONCLUSION.

Notwithstanding the generally poorer quality of the juice this season as compared with last, the results have been very satisfactory. The increase in sugar is entirely due to greater economy in working the house.

The large quantity of sugar formerly lost in the scums has been saved; the proportion of sugar left in the bagasse has been greatly reduced; and the loss from inversion in the open copper evaporator diminished. This latter loss is still entirely too large, and should be reduced to a minimum by increased facilities for evaporation in vacuo.

The production of sugar in Louisiana could doubtless be largely increased by improvements in fertilization resulting in an increase in the sugar content of the cane. Money expended in experiments with fertilizers will amply repay the planter. The experiment station established by the Planters' Association is a step in the right direction, and should be supplemented by other stations in different parts of the State.

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